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ABSTRACT

This industrial arts program of a studies guide is the product of a research project designed to (1) ascertain programs and curricula trends of senior high school industrial arts in the fifty states, (2) develop a philosophical rationale for senior high schools in North Dakota secondary schools, and (3) develop a master plan and program of study for senior high school course offerings for North Dakota. The guide is divided into six major sections: basic beliefs about industrial arts, the industrial arts mission, industrial arts objectives, the total industrial arts curriculum, program standards, and the identification of courses and course code numbering systems. The curriculum and program of studies is centered around three technical areas: graphic communications technology, production technology, and energy/power technology. For each course title listed under these areas, a course description, selected student competencies, and suggested instructional units are given. (LRA)

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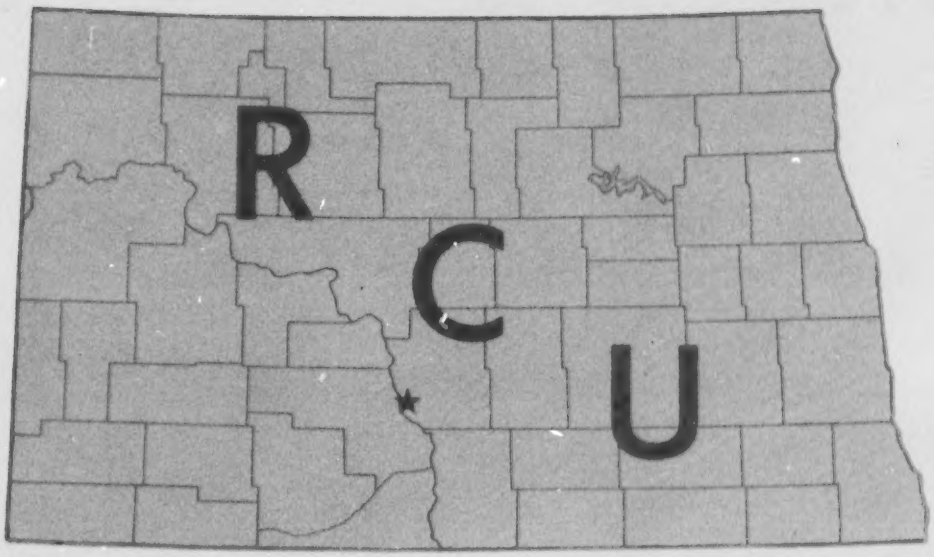
RESEARCH SERIES NO. 80

North Dakota Senior High Industrial Arts Program of Studies—Level II



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RESEARCH COORDINATING UNIT

STATE BOARD FOR VOCATIONAL EDUCATION
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ABSTRACT

TITLE: Curriculum Master Plan for Senior High Industrial Arts Programs in North Dakota

PROJECT DIRECTOR: Dr. Myron Bender, Professor and Chairman

INSTITUTION: Department of Industrial Technology
University of North Dakota

LOCATION: Grand Forks, North Dakota 58202

PROBLEM: The primary purpose of this research project was to develop a Program of Studies Guide for senior high school industrial arts programs for North Dakota secondary schools.

A survey was conducted to determine which of the fifty states have a senior high school program of studies for industrial arts and to ascertain whether these programs are articulated with junior high industrial arts and/or senior high Trade and Industrial Vocational courses. Thirty-nine of the fifty states responded to the survey questionnaire. Twenty out of the 39 states who participated in the study indicated that they do have an approved or standardized list of senior high industrial arts courses. Furthermore, it was determined that most states articulate industrial arts course offerings with vocational Trade & Industrial programs to avoid duplication.

Twenty-six of the thirty-nine states indicated that senior high school industrial arts programs are supported financially with vocational funding sources. Another interesting finding was when asked whether their states require special teacher certification requirements (such as work experience) to qualify for teaching senior high industrial arts courses, one state indicated that work experience is required while thirty-eight responded that no special certificate requirements are required and/or recommended in their states.

The findings of the survey were used to develop a senior high program of studies for North Dakota secondary school industrial arts programs. Through a series of workshops/conferences and a writing session, a North Dakota Senior High

Industrial Arts Program of Studies Guide was developed. The guide contains the following: (1) Description of types of industrial arts programs; (2) Basic beliefs, mission and goals of industrial arts; (3) Program standards and course code system; and a list of courses to be offered at the senior high level in North Dakota secondary schools.

FINAL REPORT

NORTH DAKOTA SENIOR HIGH INDUSTRIAL ARTS PROGRAM OF STUDIES

Myron Bender, Project Director
University of North Dakota
Department of Industrial Technology
Grand Forks, North Dakota

Supported By
The North Dakota State Board for Vocational Education
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1979

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PREFACE

The Industrial Arts curriculum has boundless potential for courses and program development. Scores of courses are currently provided, while potentially hundreds could be offered. Although this program possibility excites the imagination it indicates the significance in determining what should be of greatest value for the student to experience.

Thus, the development of an appropriate or model curriculum requires a critical examination of several undergirding questions: What is the overall responsibility of Industrial Arts? What Industrial Arts goals are appropriate for the different grades or school levels? What courses constitute a meaningful curriculum for these goals to be realized? What shall be the scope and sequence of the total curriculum? The answers to these questions have been addressed by a North Dakota Industrial Arts Master Plan curriculum committee and are presented in the program of studies included herein.

The Industrial Arts Program of Studies presents the complete secondary school Industrial Arts curriculum recommended for grades seven through twelve in North Dakota secondary schools. This Program of Studies emphasizes the Level II Senior High programs with specific courses, course descriptions, objectives and units of instruction. The Junior High-Level I program is dealt with in a general basis for the purpose of articulating the two levels within the total secondary school industrial arts program.

Three types of Industrial Arts programs are included in this Guide along with the individual courses which constitute the complete secondary school curriculum:

1. ORIENTATION AND EXPLORATION -- Level I program designed for grades seven through nine. The purpose of this program is to provide students with first-hand exploratory experiences in the four technical cluster areas. The learning experiences should provide an awareness of the impact of industry and it's associated technologies on the lives of individuals. Furthermore, this program assists individuals in making informed and meaningful occupational/career choices.

2. PERSONAL ENRICHMENT -- The program designed to prepare students with a general education of technological literacy, avocational skills and consumer information. This is purely an elective program for students who desire to gain an understanding of the technical concepts for personal satisfaction.

3. PRE-TECHNICAL -- This program provides concentrated and specialized technical courses for grades ten through twelve. These course are articulated with the Level I technical cluster areas. Students at this level have a wide range of interests, abilities, and life aspirations. Therefore, the key element for the senior high pre-technical program is flexibility to meet the varied needs of learners. The program is designed to prepare students for advanced educational or training programs.

ACKNOWLEDGEMENTS

The North Dakota Industrial Arts profession is indebted to the individuals who gave their time and talents in the development of this Senior High School program of studies guide.

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INTRODUCTION

Problem: To research and develop a curriculum "Master Plan" for senior high school industrial arts programs in North Dakota.

Rationale: Living in the complexities of our world requires a literate citizenship as never before. On one hand we find ourselves faced with a "shrinking planet" as transportation and communication systems become more efficient and as the "finiteness" of our resources become evermore evident. On the other hand, we find the sophistication of our technology to be bordering on the spectacular as it strives to meet the growing and many times unjustified demands of our society. To be a contributing member in this dynamic society, one must have a thorough understanding of its multi-faceted make-up and its relationship to oneself.

Thus, we find ourselves in an industrial and technological culture that is tremendously complex and rapidly changing. This change is accelerating at an unparalleled velocity in both the rate of change and the increase in the magnitude of the change. The impact that it has on our every day lives, though enormous, many times is unrealized by the general public.

An industrial arts program must also meet the diverse career needs of our society. Dr. Sidney Marland (HEW) indicated that:

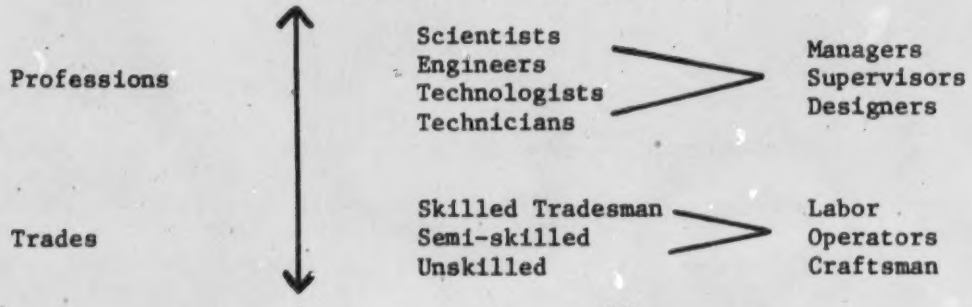
> career education provides a broad approach to preparation for citizenship; provides job information, and also helps individuals develop attitudes about the personal, psychological, social and economic significance of work in our society.

This dimension of careers has taken on a new significance as industry and technology have rapidly developed. To compliment (not replace) the trade base of the vocational T & I thrust, industrial arts education

programs must also provide educational experiences for the future "professionals" in industry. The professional career dimension in the program opens up a tremendous opportunity for secondary school students. On the other hand, industrial arts can provide exploratory and semi-specialized technical experiences for students interested in enrolling in post-secondary vocational and/or technical programs.

Along with an understanding of the careers involved in the total spectrum of industry, students must also be aware of the levels of preparation dictated by the level of the career in the spectrum.

INDUSTRIAL CAREER SPECTRUM



Careers play an important and integral part of the rationale for industrial arts education. This concepts has become an important part of the North Dakota Level I (Junior High School) curriculum that was developed during the past three years and is currently being implemented across the state. This phase of the curriculum project has been well received by both teachers and administrators because of it's current and relevant content.

This research project was undertaken to develop parameters for senior high school industrial arts course offerings in North Dakota

secondary schools. A review of current literature revealed that many contemporary senior high industrial arts programs base their content selection on industry, technology, and industrial technology. Industry and technology are two distinctively different entities; yet they are very closely related in their impact on society. Industry is a social institution, while technology focuses on mankind's practice. The body of knowledge for senior high industrial arts education must be carefully designed. In the past we have approached too many programs from a procedural orientation and an application oriented technology involved by industry. This approach has come at the expense of a creative problem-solving educational orientation and investigative (science) oriented technology.

Curriculum decisions concerning courses and content for industrial arts education must be based on a rationale. A rationale dictates that the decision makers address the question of why certain courses, content and experiences are to be included in the program. Three elements need to be addressed in developing a rationale:

1. The needs and interests of the individual students.
2. The needs of society within which the student lives.
3. The dynamic subject matter base.

Too often educators ignore the difficult issues that are posed by working through a sound rationale. However, the program that is ultimately developed will be shaped by early decisions regarding the structuring of knowledge as a base for determining courses to be offered and selecting content relevant to present and future needs of individuals.

If the outcome of the educational process is to prepare people to live self-fulfilling lives and to be contributing and/or participating

members of society, we have to prepare them to deal with both the social institution of industry and the dominant knowledge base of technology. If a student needs to develop occupational entry level competence for a trade, he or she should be given an opportunity to acquire it. Consequently, it is important to articulate the senior high industrial arts program with the Vocational Trade and Industrial course offerings. To give this opportunity in a rapidly changing society will require a truly well balanced and dynamic curriculum and program of studies.

METHODOLOGY & DESIGN

The major objectives for this research project were: (1) to ascertain programs and curricula trends of senior high school industrial arts in the fifty states; (2) to develop a philosophical rationale for senior high schools in North Dakota secondary schools; and (3) to develop a "Master Plan" and "Program of Studies" for senior high course offerings for North Dakota.

The project design was primarily a study group process utilizing existing leadership and resource personnel and services available in the state of North Dakota. The initial data were collected by a survey instrument designed to solicit information from which National curriculum trends were derived. This data provided the study group with a basis for developing a foundation for the industial arts "Program of Studies" guide for North Dakota secondary school offerings.

In addition to the survey conducted, an ERIC search was made to identify model curriculum plans that have been developed on the national scene. These programs were reviewed by the study group as background for this project.

Through a series of meetings attended by North Dakota secondary school industrial arts teachers, teacher educators, the State Trade and Industrial Education Supervisor, the State Industrial Arts Supervisor, a representative of the state's local Vocational director, and the coordinator of the Vocational Research unit, a study was made on existing conditions and to determine changes that needed to be made for improving the current industrial arts program.

The overall intent was to develop a senior high industrial arts program of studies guide that would be articulated with the junior high industrial arts curriculum that had been developed and implemented in North Dakota junior high schools during the past four years. On the other hand, the senior high school industrial arts program of studies was articulated with the Vocational Trade and Industrial programs at the secondary level.

The industrial arts and the Vocational Trade and Industrial Education programs must work together in North Dakota. The study group concluded early in the study that an essential factor in the implementation of programs in both areas requires a plan under which programs can work together in harmony, share resources where possible, yet maintain their separate identities.

FINDINGS & RESULTS

After the foundation had been laid by the study group on the basis of the data collected; time was devoted to establishing parameters for the senior high school "Program of Studies Guide. These were:

1. Basic Beliefs About Industrial Arts
2. The Industrial Arts Mission
3. Industrial Arts Objectives
4. Total Industrial Arts Curriculum K-12
5. Program Standards
6. Identification of Courses & Course Code Numbering Systems.

BASIC BELIEFS ABOUT INDUSTRIAL ARTS

INDUSTRIAL ARTS IS .....

- *an educational discipline founded upon the knowledge base of technology - the means by which material things are produced.
- *an instructional program affording boundless opportunities for learning how technology has been, is now and will be basic to human desires and needs.
- *a fundamental educational program that can serve educational priorities, whether they are academic education, general education, vocational education, career education, ad. inf.
- *an activity based curriculum enabling students to learn through doing.
- *logically a discipline with a curriculum continuum from grade K through 12.

INDUSTRIAL ARTS IS JUSTIFIED BECAUSE .....

- *all persons need to know about the technological environment, the material culture, and industry because they are economically, socially and emotionally affected by them.
- *all persons must make a career choice from an extremely large and increasing number of occupations that are affected by technology; therefore, they should have opportunities to develop interests, uncover talents, explore technical and applied science fields and study occupations.
- *all persons must select, buy, use, and maintain the products of industry -- houses, automobiles, appliances, clothes, furniture and items of a never ending list. A knowledge of products, their manufacture, characteristics, advantages and disadvantages makes for intelligent consumption.
- *all persons need recreational, leisure time and avocational outlets.
- *all persons need to have opportunities to develop planning, creative, problem solving and technical skills in harmony with their inherent desire to seek the better way.

INDUSTRIAL ARTS CAN HELP THE STUDENT TO .....

- *gain an understanding of industry and technology.
- *discover interests and talents.
- *develop techniques in problem solving.
- *develop basic skills in the safe use of tools and machines.
- *make informed and meaningful occupational choices.
- *acquire interests in avocational pursuits and hobbies.
- *develop safe working habits.
- *apply other school subjects.
- *become a wiser consumer.
- *develop creativity.
- *develop pride in work well done.
- *work cooperatively with others.

THE INDUSTRIAL ARTS MISSION

The mission of Industrial Arts Education is to assist the student in developing an understanding about industry and technology and in the discovery and development of individual potential.

GOALS

Consistent with their abilities, interests and educational needs:

1. Industrial Arts students at the middle or junior high school level will be aware of employment and/or self-employment opportunities and requirements for use in making career choices and in determining their educational programs.
2. Industrial Arts students at the senior high school level will acquire technical competencies in preparation for advanced vocational or technical education programs.
3. Industrial Arts students at the senior high school level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time.

INDUSTRIAL ARTS: AN OFFICIAL DEFINITION

Industrial Arts education programs means those education programs which pertain to the body of related subject matter, or related courses, organized for the development of understanding about the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology including learning experiences involving activities such as experimenting, designing, constructing, evaluating, and using tools, machines, materials, and processes which provide opportunities for creativity and problem solving or assist individuals in the making of informed and meaningful occupational choices or which prepare them for entry into advanced trade and industrial or technical education programs.

INDUSTRIAL ARTS INSTRUCTIONAL OBJECTIVES

Industrial Arts students at the Senior High School Level will acquire competencies that lead to responsible citizenship through technological understanding, consumer knowledge and the productive use of leisure time. The program stresses the following instructional objectives:

1. Develop an insight and understanding of industry and technology, its place in our society and the free enterprise system.

2. Discover and develop individual talents, aptitudes, interests, and potentials as related to industry and technology.

3. Develop an understanding of industrial processes and the practical application of scientific principles.

4. Develop technical problem-solving and creative abilities involving the use of materials, processes, and products of industry and technology.

5. Develop an understanding of industrial and technological career opportunities and their requirements and develop those traits which will help students obtain and maintain employment.

As determined by Title II of PL No. 94-482, the Vocational Education Act of 1976 and the State Board for Vocational Education, the purpose of funding industrial arts programs with vocational monies will be to:

1. Assist individuals in the making of informed and meaningful occupational and educational choices.

2. Prepare individuals for enrollment in advanced or highly skilled vocational and technical programs.

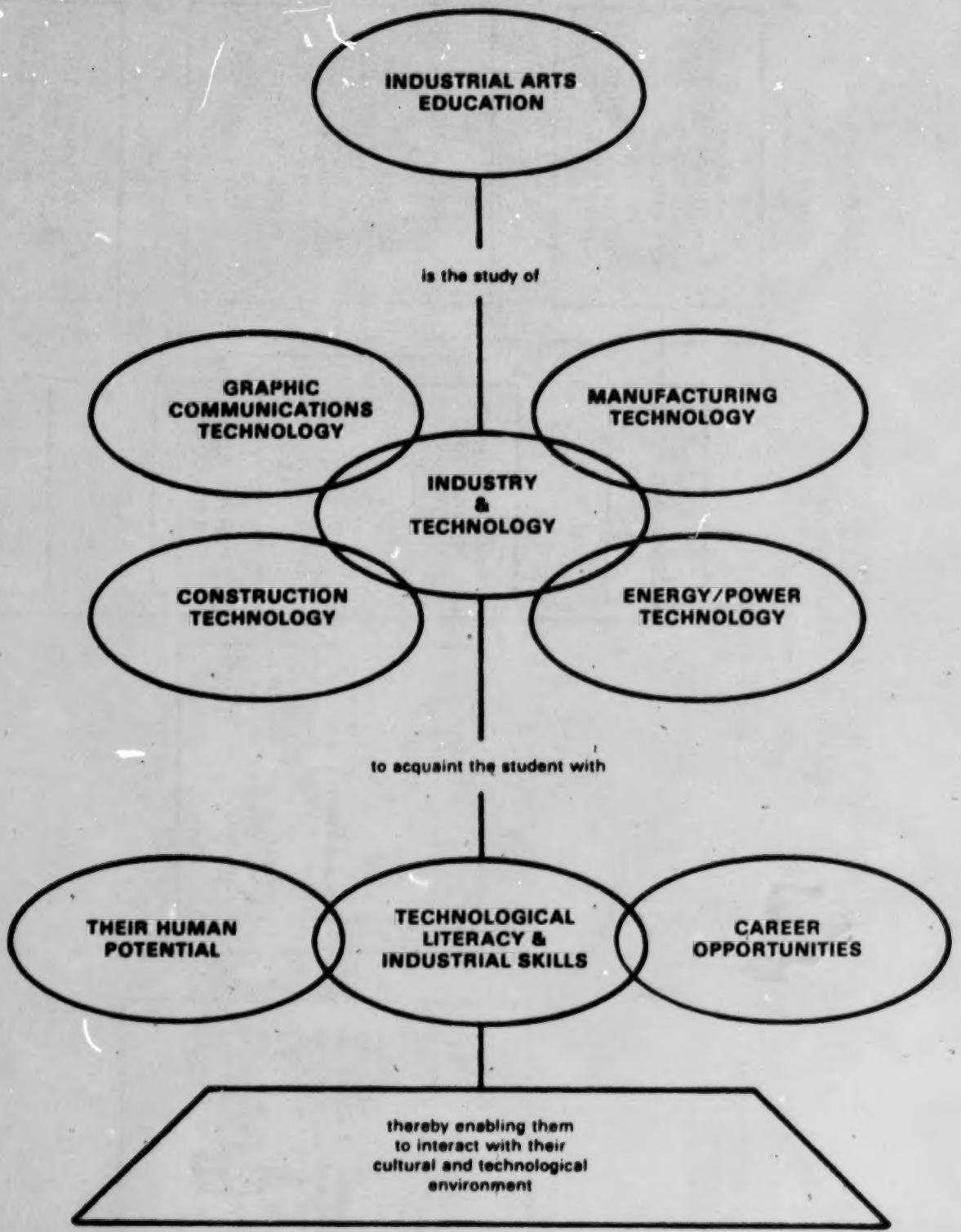

INDUSTRIAL ARTS EDUCATION
is the study of
GRAPHIC COMMUNICATIONS TECHNOLOGY
MANUFACTURING TECHNOLOGY
INDUSTRY & TECHNOLOGY
CONSTRUCTION TECHNOLOGY
ENERGY/POWER TECHNOLOGY
to acquaint the student with
THEIR HUMAN POTENTIAL
TECHNOLOGICAL LITERACY & INDUSTRIAL SKILLS
CAREER OPPORTUNITIES
thereby enabling them to interact with their cultural and technological environment

Figure 1

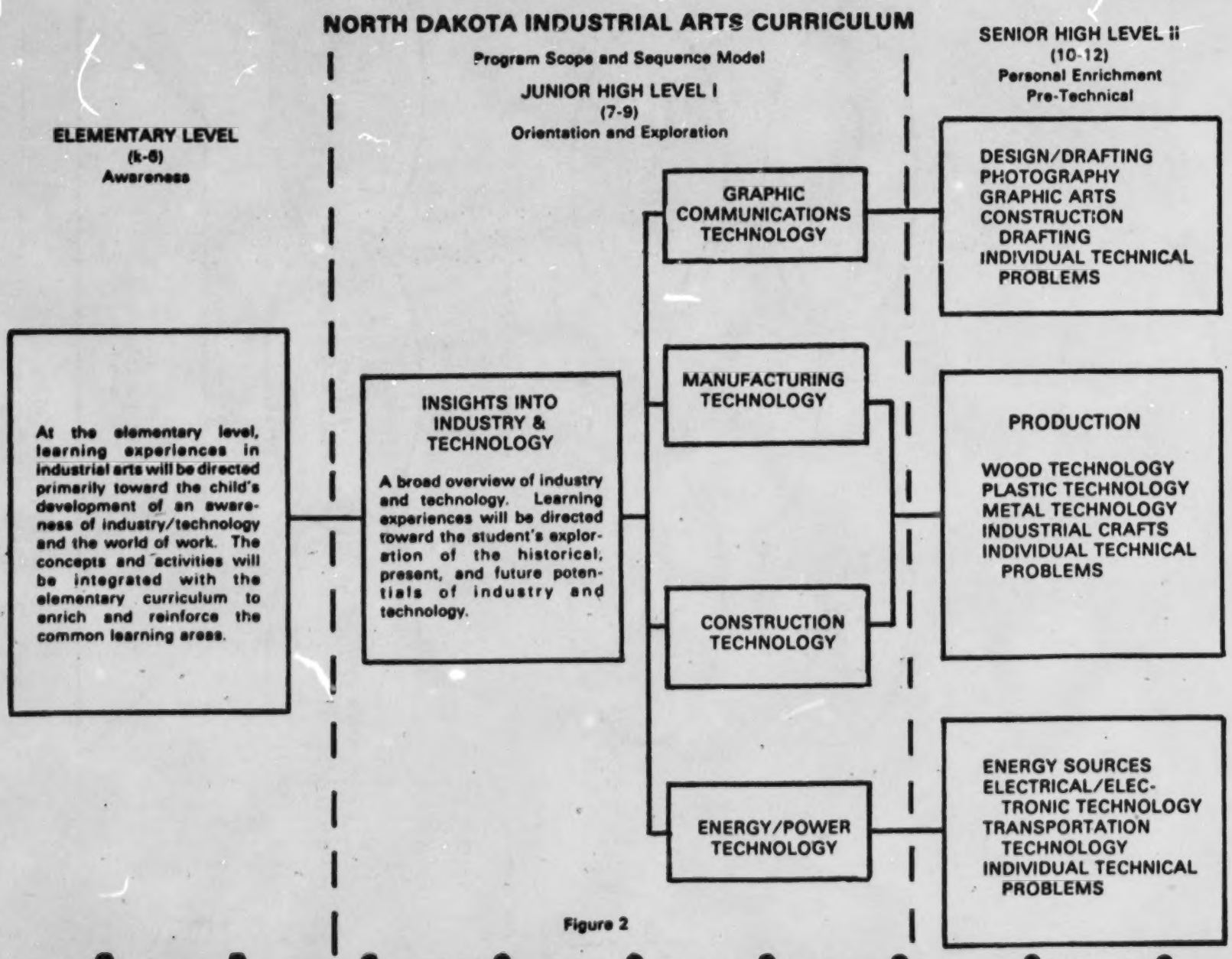

NORTH DAKOTA INDUSTRIAL ARTS CURRICULUM
Program Scope and Sequence Model
ELEMENTARY LEVEL
(k-6)
Awareness
JUNIOR HIGH LEVEL I
(7-9)
Orientation and Exploration
SENIOR HIGH LEVEL II
(10-12)
Personal Enrichment
Pre-Technical
At the elementary level, learning experiences in industrial arts will be directed primarily toward the child's development of an awareness of industry/technology and the world of work. The concepts and activities will be integrated with the elementary curriculum to enrich and reinforce the common learning areas.
INSIGHTS INTO INDUSTRY & TECHNOLOGY
A broad overview of industry and technology. Learning experiences will be directed toward the student's exploration of the historical, present, and future potentials of industry and technology.
GRAPHIC COMMUNICATIONS TECHNOLOGY
MANUFACTURING TECHNOLOGY
CONSTRUCTION TECHNOLOGY
ENERGY/POWER TECHNOLOGY
DESIGN/DRAFTING
PHOTOGRAPHY
GRAPHIC ARTS
CONSTRUCTION DRAFTING
INDIVIDUAL TECHNICAL PROBLEMS
PRODUCTION
WOOD TECHNOLOGY
PLASTIC TECHNOLOGY
METAL TECHNOLOGY
INDUSTRIAL CRAFTS
INDIVIDUAL TECHNICAL PROBLEMS
ENERGY SOURCES
ELECTRICAL/ELECTRONIC TECHNOLOGY
TRANSPORTATION TECHNOLOGY
INDIVIDUAL TECHNICAL PROBLEMS

Figure 2

THE INDUSTRIAL ARTS PROGRAM OF STUDIES

LEVEL	GOAL	PROGRAM
II HIGH SCHOOL (Grades 10, 11, & 12)	1. Personal Enrichment 2. Pre-Technical	GRAPHIC COMMUNICATIONS TECHNOLOGY •Design/Drafting •Photography •Graphic Arts •Construction Drafting •Industrial Technical Problems ENERGY/POWER TECHNOLOGY •Energy Sources •Power Technology •Electrical/Electronic Technology •Transportation Technology •Individual Technical Problem PRODUCTION TECHNOLOGY •Wood Technology •Metal Technology •Plastic Technology •Industrial Crafts •Individual Technical Problems INDIVIDUAL TECHNICAL PROBLEMS (Multiple Offerings)
I JUNIOR HIGH SCHOOL (Grades 7, 8, &9)	1. Orientation 2. Exploration	•Insights into Industry and Technology •Graphic Communications Technology •Manufacturing Technology •Construction Technology •Energy/Power Technology

Figure 3

PROGRAM STANDARDS FOR INDUSTRIAL ARTS

ELEMENTS OF QUALITY INDUSTRIAL ARTS PROGRAMS

The success and quality of programs in industrial arts education depends upon elements that influence the quality of programs. Industrial arts must be responsive to the following elements:

A. GOALS AND OBJECTIVES: Program goals and objectives are established that provide the inspiration and guidance in program development, operation and evaluation.

B. INSTRUCTIONAL STAFF: The instructional staff is competent and meet necessary qualifications.

C. INSTRUCTIONAL PLAN: Selected subject matter is appropriate to learner's level and consistent with curriculum and course goals and objectives.

D. STUDENT ORGANIZATIONS: The establishment and operation of effective student organizations.

E. FACILITIES AND EQUIPMENT: Instructional facilities are well-designed, located and supportive of accomplishing curricular goals. (Refer to Educational Specifications for Industrial Arts Instructional Facilities Handbook, 1978.)

F. SPECIAL NEEDS: The program must provide for disadvantaged and handicapped students.

G. ADVISORY COMMITTEES: The establishment and effective use of industrial arts advisory committees.

H. GUIDANCE: The teacher's role in guidance.

I. ADMINISTRATION: Administration of the industrial arts program.

J. EVALUATION: Evaluation procedures are planned and implemented to assure continual program improvement.

NOTE: For further information on program standards, refer to the NORTH DAKOTA VOCATIONAL/TECHNICAL EDUCATION PROGRAM STANDARDS, Section 11.1 to 11.7.

INDUSTRIAL ARTS COURSE CODE NUMBERS
(Vocationally Funded)

Insights Into Industry and Technology	10001
Construction Technology	10011
Manufacturing Technology	10021
Wood Technology	10023
Metal Technology	10026
Plastic Technology	10029
Energy and Power Technology	10031
Electrical/Electronic Technology	10033
Energy Sources	10038
Power Technology	10039
Graphic Communications Technology	10051
Graphic Arts	10052
Design/Drafting	10053
Photography	10054
Construction Drafting	10056
Transportation	10061
Industrial Crafts	10060
Individual Technical Problems	10091
Individual Technical Problems	10092

GRAPHIC COMMUNICATIONS TECHNOLOGY

PROGRAM OF STUDIES

—COURSE TITLES AND CODES
—COURSE DESCRIPTIONS
—SELECTED STUDENT COMPETENCIES
—SUGGESTED INSTRUCTIONAL UNITS

DESIGN/DRAFTING

COURSE CODE: 10053

This design/drafting course provides students the opportunity to experience the language of industry and technology. Students gain a background of skills and understandings in the broad scope of design/drafting.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Graphic Communications Technology, 10051

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Narrate the contributions which design/drafting make in the development, manufacture or construction of products.
2. Determine the value and advantages of various types of drawing equipment pertinent to drafting.
3. Practice efficient and safe use of equipment and materials commonly used in design/drafting related to occupations.
4. Read and interpret multi-view, pictorial and schematic drawings.
5. Prepare multi-view, pictorial and schematic drawings through the use of instruments utilizing the proper drawing methods and conventions.
6. Evaluate the quality of current working drawing from tracing to final presentations.
7. Utilize resource and reference materials essential to major design/drafting areas.
8. Evaluate positive and negative aspects of various design/drafting related positions in terms of individual interest and aptitudes.
9. Narrate and apply the processes of design.
10. Recognize the principles of good design in commercial and student designed products.
11. Prepare working drawings that include details, assemblies and etc.
12. Assess current career opportunities in design/drafting fields.
13. Develop an appreciation for storage and retrieval of technical documents.

10053
COURSE CODE

DESIGN/DRAFTING

SUGGESTED INSTRUCTIONAL UNITS

*I. Introduction and History to Drafting

*II. Review of North Dakota Industrial Arts Curriculum Guide Level I for Graphic Communications Technology.
Unit: 2.00 Freehand
Unit: 3.00 Instrument

*III. Geometric Construction

*IV. Orthographic Projection

*V. Dimensioning (English and SI Metric)

*VI. Pictorials

*VII. Sections and Conventions

*VIII. Auxiliary Views

*IX. Production Drawing

*X. Charts and Graphs

XI. Specialized Drafting:
Construction
Mechanical
Electrical
Topographical
Etc.

*XII. Reproduction Processes

XIII. Techniques of Design

XIV. Precision Dimensions

XV. Threads and Fasteners

XVI. Revolutions

XVII. Intersections and Developments

XVIII. Technical Illustrations

XIX. Cams and Gears

XX. Technical Document Control Systems

* Recommended units of instruction for an 18-week course.

PHOTOGRAPHY

COURSE CODE 10054

This course is designed to provide students with the necessary information and techniques in photographic theory, camera function, darkroom practices and the integration of light, photographic materials, exposure, and processing chemistry. The second semester continues with special effect techniques, lighting consideration, camera and darkroom accessories, darkroom design and set-up, specialized photography areas are also introduced to the class via lecture and related laboratory activities. Basically, the black/white photography is introduced and practiced in this course.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Graphic Communications Technology, 10051

SELECTED STUDENT COMPETENCIES

Experience and activities of this industrial arts course should enable the student to:

1. Become knowledgeable of photographic theory, properties of light sensitive materials, and photographic chemistry.
2. Identify the functions of major camera elements and handle a 35mm camera properly.
3. Familiarize the operation and controls of a 35mm camera to take good, desirable pictures.
4. Demonstrate proper safety practice with regard to the facility and chemicals.
5. Process black/white negatives and printing correctly.
6. Develop proficiency in effectively composing photographs.
7. Develop proficiency in photo-image evaluation-improvement techniques.
8. Develop proficiency in communicating ideas, knowledge, or information using photography as a medium.
9. Identify the photography role in graphic communications.
10. Practice more complex negative-making methods and exposure-development control factors to consistently produce excellent prints.
11. Evaluate developed negatives and provide the solution of future improvement.
12. Produce special effect pictures with his/her own creative desires.
13. Understand what chemicals do to film and paper, and work out more intelligent and efficient processing techniques.
14. Develop proficiency in effectively controlling and using natural/artificial lights for his/her photographs.
15. Develop proficiency in selecting and manipulating camera/darkroom accessories for desirable photographs.
16. Select suitable and essential photographic equipment and materials to fulfill individual needs.
17. Develop knowledge and proficiency in specialized photography areas such as: picturing people, applied infrared photography, close-up photography, photographic illustrations, and portrait techniques, etc.

10054
COURSE CODE

PHOTOGRAPHY

SUGGESTED INSTRUCTIONAL UNITS

*I. Introduction to Photography
*II. History of Photography
*III. Photographic Principle and Theory
*IV. The Camera and Its Elements
*V. Aperture and Shutter
*VI. Taking Picture, and Film Exposure
*VII. Photographic Laboratory Safety
*VIII. Film Development
*IX. Evaluation of Negatives and the Possible Improvement
*X. Making Projection Prints
*XI. Print Processing
*XII. Evaluation of Prints and the Possible Improvement
*XIII. Finishing Techniques
*XIV. Properties and Characteristics of Photographic Materials
*XV. Photo-Communications
XVI. Negative Making Methods
XVII. Photographic Chemistry and Formulas
XVIII. Creative Darkroom Techniques
XIX. Lighting
XX. Photographic Equipment and Materials Selection
XXI. Darkroom Design and Layout
XXII. Specialized Photography

* Recommended units of instruction for an 18-week course.

GRAPHIC ARTS

COURSE CODE: 10052

This course is designed to acquaint students with current Graphic Arts processes, methods, and techniques. Through learning experiences, products related to the Graphic Arts industry will be designed and produced by individual student.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Graphic Communications Technology, 10051

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Plan effectively for reprographics products.
2. Analyze and evaluate the importance of design principles.
3. Analyze various processes used in the graphic arts industry.
4. Practice efficient and safe use of equipment and materials commonly found in the graphic arts industry
5. Become knowledgeable of the interrelatedness of various elements of the graphic arts industry
6. Develop products using the processes found in the graphic arts industry.
7. Identify the role of reprographics management.
8. Determine the need for production control.
9. Evaluate various aspects of graphic arts careers.

10052
COURSE CODE

GRAPHIC ARTS

SUGGESTED INSTRUCTIONAL UNITS

*I. Review the North Dakota Industrial Arts Curriculum Guide, Level I for Graphic Communications Technology Units:
   4.00 Design
   5.00 Image Generation
   6.00 Preproduction
   7.00 Production
   8.00 Bindery
   9.00 Careers

*II. Job Planning

*III. Design Principles
   A. Message Analysis
   B. Design
   C. Layout

*IV. Methods of Image Generation

*V. Preproduction Methods

*VI. Production
   A. Relief
   B. Offset
   C. Gravue
   D. Screen
   E. Duplicating

*VII. Bindery, Finishing and Packaging

VIII. Characteristics and Manufacturing of Materials Used in Graphic Arts

XI. Reprographics Process Trouble Shooting

X. Graphic Arts Plant Operation

*XI. Career Opportunities

* Recommended units of instruction for an 18-week course.

CONSTRUCTION DRAFTING

COURSE CODE: 10056

This course is designed to provide students with the necessary theory and techniques to read blueprints and produce working drawings in the area of residential construction.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

Graphic Communications Technology, 10051 and Design/Drafting, 10053.

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Identify the need for a complete set of drawings in relation to construction.
2. Realize the importance of legible, well prepared drawings.
3. Discuss the details related to residential construction.
4. Become familiar with the properties, functions, and sizes of various building materials.
5. Acquire a working knowledge of residential designs.
6. Identify the differences among sections, plans, and elevations.
7. Demonstrate the ability of proper dimensioning practices.
8. Discuss and use building codes and specifications.
9. Produce a complete set of proper, well executed residential construction drawings.

10056
COURSE CODE

CONSTRUCTION DRAFTING

SUGGESTED INSTRUCTIONAL UNITS

I Introduction to Construction Drafting

II Review of Drafting Procedures

III Building Codes and Office Practices Used

IV Plot or Site Plans

V Floor Plans and Utility Planning

VI. Foundation Plans

VII. Elevations

VIII. Construction Sections

IX. Construction Details

X. Presentation Drawings

XI. Career Opportunities in Construction Drawing

INDIVIDUAL TECHNICAL PROBLEMS: GRAPHIC COMMUNICATIONS

COURSE CODE: 10092

This individual technical problem course is designed for students who have had the Level II preliminary courses of this cluster in the chosen area of study and intend to study specific advanced information and techniques in design/drafting, photography, graphic arts, and/or construction drafting.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

See Course Description

Instruction in this industrial arts course is open to meet students needs. The following suggested objectives are meant to provide ideas for developing the student's program.

1. To prepare for seeking advanced education in the area of graphic communications.
2. To provide students the experiences in problem-solving, research and development with regard to any specific chosen means in graphic communications.
3. To provide students information regarding industrial mateials, processes and the practical applications of scientific principles.
4. To provide students an understanding of industry, its place in society, and the free enterprise system.
5. To provide students an understanding in related career opportunities in graphic communications.

10092
COURSE CODE

INDIVIDUAL TECHNICAL PROBLEMS: GRAPHIC COMMUNICATIONS

SAMPLE LEARNING TOPICS

DESIGN/DRAFTING:
Design/drafting as pertains to:

I. Aerospace Engineering
II. Civil Engineering
III. Electrical/Electronic Engineering
IV. Geological Enginering
V. Mechanical Engineering
VI. Marine Engineering
VII. Nuclear Engineering
VIII. Production Industry

PHOTOGRAPHY:

I. Photography Education
II. Basic Sensitometry
III. Characteristics and Applications of Various Photographic Materials
IV. Basic Scientific Photography
V. Portrait Photography
VI. Color Theory and Color Photography
VII. Safety and Health Hazards with Photographic Chemicals
VIII. Career Opportunities in Photography Related Industry

GRAPHIC ARTS:

I. Photo-Offset Process
II. Advanced Screen Printing Techniques
III. Color Separation and Reproduction
IV. Reproduction Techniques for Audio-Visual Materials
V. Modern Image Generation Methods
VI. Special Effect Reproduction
VII. Advanced Layout and Design
VIII. Market and Cost Analysis

CONSTRUCTION DRAFTING:

I. Advanced Construction Drafting Education
II. Planning and Design Considerations
III. Resource Materials for Construction Drafting
IV. Color Illustrations and Presentation Drawings
V. Architectural Model Making
VI. Landscaping Design
VII. Interior Design

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE: 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Graphic Communications Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses

SELECTED STUDENT COMPETENCIES

NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.

SAMPLE LEARNING TOPICS

NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include:

GRAPHIC COMMUNICATIONS:

-- Design/Drafting, 10053
-- Photography, 10054
-- Graphic Arts, 10052
-- Construction Drafting, 10056

PRODUCTION TECHNOLOGY

PROGRAM OF STUDIES

—COURSE TITLES AND CODES
—COURSE DESCRIPTION
—SELECTED STUDENT COMPETENCIES
—SUGGESTED INSTRUCTIONAL UNITS

WOOD TECHNOLOGY

COURSE CODE: 10023

Students design, plan and build furniture, recreational, or other wood products using machine tools, processes and wood technology. Creativity should be emphasized as students further develop their interests, talents, and abilities in production of wood products.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Manufacturing Curriculum

Course 10021 and Wood Technology, 10023

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Compare and evaluate the various characteristics of good design used in the production of furniture, cabinets, and other wood products.
2. Solve simulated industrial design or planning problems in the production of a product.
3. Discuss critically how designing and planning relate to the fabrication of furniture and cabinets in various types of industrial production.
4. Solve problems related to commercial types and applications of finishes.
5. Devise, compare and estimate the specific industrial experience, applications or operations necessary for the production in quantity of a particular product made of wood or a related forestry product.
6. Evaluate the application of wood technology in the fabrication of industrial products.
7. Evaluate the quality of finishing materials.
8. To determine and solve technical problems relating to wood technology.
9. Use safe work habits and to promote safety consciousness.

10023
COURSE CODE

WOOD TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

I. Standardized Materials of Wood Technology
   A. Formation Anatomy and Properties of Wood
      1. The plant origin of wood
      2. The woody plant cell
      3. Tree growth
      4. The structure of hardwoods
      5. The structure of softwoods
      6. Features of wood of value in identification
   B. Physical Nature of Wood Nonmechanical Properties
      1. Wood-moisture relationship
      2. Dimensional changes in wood
      3. Specific gravity and density of wood
      4. Thermal properties of wood
      5. Electrical properties of wood
      6. Permeability of wood
      7. Acoustical properties of wood
   C. Degrade of Wood Materials
      1. Variability of wood within a species
      2. Growth related defects in wood
      3. Defects due to seasoning and machining
   D. Wood Composites
   E. Millwork and Molding
   F. Hardware
   G. Fasteners
   H. Adhesives

*II. Safety and Accident Prevention
   A. Introduction
   B. Machine Safety
   C. Safety Equipment

*III. Processes
   A. Sawing
   B. Shaping
   C. Boring
   D. Turning
   E. Bending

*IV. Design of Wood Products
   A. Historical Design
      1. Period Furniture
      2. Traditional design
   B. Design Factors
      1. Principle of design
      2. Ornamentation
      3. Decorative environment
      4. Effects of color
      5. Upholstery
   C. Structural design
      1. Selecting construction methods
      2. Joint selection
      3. Making and reading plans
      4. Determining wood costs

*V. Cabinet Construction
   A. Joinery
   B. Frame and Panel
   C. Leg and Rail
   D. Cabinet and Furniture Door
   E. Drawers and Guides
   F. Cabinet Interiors
   G. Leg and Post
   H. Table and Cabinet Tops

*VI. Wood Preservation (Finishes)
   A. Materials
   B. Application

*VII. Career Opportunities in the Wood Industry

VIII. Tool Maintenance

* Recommended units of instruction for an 18-week course.

PLASTIC TECHNOLOGY

COURSE CODE: 10029

This course is designed for students who want to know the nature, processes and career opportunities in Plastic Technology.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

Level I Manufacturing Technology, 10021, and Wood Technology, 10023

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Identify the historical aspects of the industry.
2. Demonstrate the skills in application, classification and standard forms of plastic materials.
3. Perform destructive and non-destructive identification, properties and chemicals analysis tests.
4. Demonstrate molding and forming processes.
5. Demonstrate moldmaking principles and design of various materials.
6. Identify and demonstrate bonding processes.
7. Perform low and high pressure laminating processes.
8. Demonstrate encapsulation processes.
9. Identify and perform processes of foaming systems.
10. Identify and demonstrate coating process.
11. Identify and perform dispersion systems.
12. Identify and perform decorating and finishing processes.
13. Discuss, identify, and relate to career opportunities in the plastic technology industry.

10029
COURSE CODE

PLASTIC TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

*I. Introduction and Orientation
- A. History and Growth of the Plastic Technology
- B. Application of Plastic Products
- C. Classification and Identification of Plastic Materials
- D. Standardized Plastic Materials

II. Testing and Chemistry of Plastics
- A. Non-destructive Tests
- B. Destructive Identification Tests
- C. Chemical Bonding
- D. Differential Properties

*III. Molding and Forming
- A. Injection Molding
- B. Blow Molding
- C. Compression Molding
- D. Thermoforming

IV. Moldmaking
- A. Principles of Moldmaking Design
- B. Elastomers
- C. Casting with Silicone Rubber

V. Bonding
- A. Welding and Cementing
- B. Heat Sealing

*VI. Laminates
- A. Reinforced Plastics
- B. High and Low Pressure Laminating

VII. Encapsulation
- A. Casting and Embedding

*VIII. Foaming Systems
- A. Expandable Bead Foam
- B. Expandable Resin Foam

IX. Coating
- A. Coating Processes
- B. Cold Dip Coating
- C. Fluidized Bed Coating
- D. Vacuum Metalizing
- E. Electroplating

X. Dispersion Systems
- A. Vinyl Dispersion
- B. Rotational Molding
- C. Thermofusion Molding

XI. Decorating
- A. Decorating, Coloring, Finishing and Restoration
- B. Hot Foil Stamping
- C. Machine Engraving

XII. Career Opportunities in Plastic Technology

* Recommended units of instruction for an 18-week course.

METAL TECHNOLOGY

COURSE CODE 10026

This course is designed for the student to achieve extended pre-technical and personal enrichment goals. The experiences and activities deal with the technology of metal, the materials, processes, applications and career opportunities in the industry.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Course and Wood Technology, 10023

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Describe properties of various metals, such as, characteristics and mechanical properties of steel, aluminum and copper.
2. Relate metal properties to economic, manufacturing and service requirements to match the material to the job.
3. Identify various metals and correctly classify them.
4. Plan for the production of a metal product.
5. Safely set-up and operate common metal cutting and forming equipment.
6. Safely operate combining and conditioning equipment using approved methods.
7. Identify and use appropriate fasteners in the assembly of metal products.
8. Work from drawings accurately and perform measuring and laying out operations.
9. Determine and use finishing materials for protection and beauty.
10. Describe qualifications and responsibilities for various careers in metal technology.
11. Exhibit orderly work habits and show considerations for fellow students safety.

10026
COURSE CODE

METAL TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

I. Metal Materials
- A. The Nature of Metal Materials
  1. Physical Characteristics
  2. Bonding Properties
  3. Behavioral Properties
- B. Material Requirements
  1. Manufacturing
  2. Service
  3. Selection
- C. Material Classification
  1. Ferrous
  2. Non-Ferrous
  3. Alloys
- D. Standardized Metal Materials

II. Processes
- *A. Metal Cutting and Forming
  1. Principles of metal separation
  2. Metal Separation by Shearing and Drilling
  3. Practices of Metal Forming
- *B. Combining and Conditioning
  1. Bonding-Processes by Joining
  2. Bonding by Heat and Pressure
  3. Bonding with Chemical Heat
  4. Separating Bonds by Heat
  5. Adhesive Bonding
  6. Conditioning and Restoration Processes

III. Application: Manufacturing Finished Products
- *A. Product Planning
  1. Measuring and Laying Out Metals
  2. Reading Blueprints
  3. Metal Product Design
- B. Principles and Practices of Assembly
  1. Assembly Principles
  2. Assembly Operations
- C. Metal Finishing Processes
  1. Finishing Principles
  2. Finishing Materials and Applications

IV. Career Opportunities in Metal Technology
- *A. Career Classifications
  1. Semiskilled
  2. Skilled
  3. Technical
  4. Professional

* Recommended units of instruction for an 18-week course.

INDUSTRIAL CRAFTS

COURSE CODE: 10080

The industrial crafts program allows students to experience a variety of materials, while creating well-designed and useful objects. Students develop competencies in using selected tools and processes of the industrial crafts area while developing products.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course will enable the student to:

1. Study the crafts industry to determine the present status in our society and the future opportunities that might be available.
2. Identify different production techniques used in the industrial crafts.
3. Identify and describe the personnel that make up this industry.
4. Demonstrate an ability to design industrial craft products.
5. Practice safe work habits when using the tools of the craft industry.
6. Identify and perform industrial crafts processes, such as forming, fastening, assembling, and finishing.
7. Practice quality control during the production of a product.
8. Demonstrate problem-solving and creative abilities in the selection and use of suitable materials.
9. Demonstrate cooperative attitudes and good work habits.
10. Produce industrial craft products of quality and craftsmanship.
11. Identify craft areas and their contribution to the American economy and culture.

10080
COURSE CODE

INDUSTRIAL CRAFTS

SUGGESTED INSTRUCTIONAL UNITS

I. Craft Industry
   - A. The Economics of American Crafts
     1. The development of American Crafts as an economic force
     2. Available markets
   - B. Marketing Industrial Crafts
     1. Advertising
     2. Sales
   - C. Production
     1. Individual
     2. Collective work
     3. Mass production
     4. Craft cooperatives
   - D. People in the Industry
     1. Creativity
     2. Individualism
     3. Age span
     4. Education and training required
     5. Physical attributes
   - E. The Consumer

II. Crafts Planning and Design
   - A. Design
     1. New and original
     2. Design integrity
     3. Descrimination
     4. Quality
     5. Elements and principles
   - B. Measurement and Layout
   - C. Sketching
   - D. Safety

III. Material Processes
   - A. Tools of the Trade
   - B. Forming
   - C. Fastening
   - D. Assembly
   - E. Finishing
   - F. Quality Control
   - G. Safety

IV. Material Selection
   - A. Outcomes desired
   - B. Economy
   - C. Adaptability
   - D. Characteristics

V. Craft Material Areas
   - A. Metal
   - B. Wood
   - C. Plastic
   - D. Leather
   - E. Jewelry and Gems
   - F. Fibers
   - G. Ceramics
   - H. Graphics
   - I. Composites

INDIVIDUAL TECHNICAL PROBLEMS: PRODUCTION

COURSE CODE: 10092

This individual technical problem course is designed for students who have had the Level II preliminary course of this cluster in the chosen area of study and intend to study specific information and techniques in wood, plastic, metal technology courses and/or industrial crafts.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses and Level II

Instruction in this industrial arts course is open to meet student needs. The following suggested objectives are meant to provide ideas for developing students programs.

1. To prepare students for seeking advanced education in the area of production.
2. To provide students the experiences in problem-solving, research and development with regard to any specific topic in production courses.
3. To provide students with information regarding industrial materials, processes and the practical applications of scientific principles.
4. To provide students with an understanding of industry, it's place in society, and the free enterprise system.
5. To provide students with an understanding in related career opportunities in production.

10092
COURSE CODE

INDIVIDUAL TECHNICAL PROBLEMS:

PRODUCTION

SAMPLE LEARNING UNITS

WOOD TECHNOLOGY:

I. Anatomical Structure of Wood
II. Forest Ecology
III. Physical Nature of Wood
IV. Wood Defects
V. Lamination Processes
VI. Peg Diffusion
VII. Wood Plastic Composition
VIII. Residential Construction
  A. Sub-structure
  B. Super-structure
IX. Commercial Construction
X. Wood By-Products
XI. Product Design
XII. Product Finishing
XIII. Preservation Materials
XIV. Occupations - Present and Future
XV. Safety Development
XVI. Prototype Construction
XVII. Bending Fixtures

METAL TECHNOLOGY:

I. EDM
II. Chemical Milling
III. Explosive Forming
IV. Adhesives
V. Investment Casting
VI. Forging
VII. Heat Treatment of Metals
VIII. Metal Turning
IX. Extrusion Processes
X. Powder Metallurgy
XI. Multi-Related Problems
XII. Automation
XIII. Accident Prevention Study

PLASTIC TECHNOLOGY:

I. Mold Construction
  A. Expandable Bead Molds
  B. Liquid Plastic Molding
  C. Vacuum Forming Molds and Rotational
II. Decorating and Finishing Applications of Plastic
  A. Advertising
  B. Natural Finishes

III. Study Developments of Future Applications of Plastic
IV. Uses of and Choices of Bonding Agents
V. Plastic Products
   A. Production of Plastic Products
   B. Study of Industrial Processes
VI Study of Optical Properties
VII. Plastic Products
VIII. Safety and Health Hazards of Toxic Fumes From Plastic Materials

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE: 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Production Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses

SELECTED STUDENT COMPETENCIES

NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.

SAMPLE LEARNING TOPICS

NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include:

PRODUCTION TECHNOLOGY:

-- Wood Technology, 10023
-- Metal Technology, 10026
-- Plastic Technology, 10029
-- Industrial Crafts, 10080

ENERGY/POWER TECHNOLOGY

PROGRAM OF STUDIES

—COURSE TITLES AND CODES
—COURSE DESCRIPTIONS
—SELECTED STUDENT COMPETENCIES
—SUGGESTED INSTRUCTIONAL UNITS

ENERGY SOURCES

COURSE CODE: 10038

This course is designed to help students learn about the application of energy and energy sources, along with the various collection systems. Students apply theory to practical collection or conversion of energy sources. Career opportunities are also explored.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Determine some of the economic and social effects which energy has on society.
2. Determine the working conditions in a service enterprise.
3. Demonstrate the principles of use of various energy sources.
4. Describe collection systems related to specific energy sources.
5. Exhibit safe practices with energy sources, in working with tools and equipment.
6. Demonstrate the ability to adjust and repair energy systems.
7. Exhibit efficiency in use of time.
8. Demonstrate a willingness to use good work habits of orderliness, cleanliness, and care of property.
9. Identify occupational preparation programs available in the area of energy sources.

10038
COURSE CODE

ENERGY SOURCES

SUGGESTED INSTRUCTIONAL UNITS

I. Introduction to Energy Sources
   A. Safety
   B. Occupational Information

II. Chemical Energy
   A. Fossil Fuels
   B. Bio Fuels

III. Electrical Energy
   A. Electrostatic
   B. Magnetic

IV. Light Energy
   A. Solar
   B. Radioactive

V. Mechanical Energy
   A. Wind
   B. Water
   C. Gravitational

VI. Nuclear Energy
   A. Atomic
   B. Solar

VII. Thermal Energy
   A. Geothermal
   B. Solar
   C. Cryogenic (super cold)

VIII. Careers in Energy

POWER TECHNOLOGY

COURSE CODE 10039

This course is designed to provide students with the necessary information and techniques so they may apply or understand the conversion or transmission of traditional power sources, along with the various types of power of the future. Career opportunities will also be explored.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Determine some of the economic and social effects which power technology has on society.
2. Evaluate the methods and processes used by industry to transmit or convert energy.
3. Discuss the development of thermal, mechanical and fluid power.
4. Exhibit safe practices in working with power systems, tools, and equipment.
5. Critically discuss the principles of various internal and external combustion engines or power plants.
6. Design, plan and/or modify a small power product.
7. Critically discuss the application of mechanical systems.
8. Analyze through experimental procedures various power systems.
9. Identify and select appropriate power systems for practical applications.

10039
COURSE CODE

POWER TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

*I. Introduction
   A. Safety
   B. Occupational Information

*II. Conversion of Power
   A. Internal Combusion
      1. 4-cycle
      2. 2-cycle
      3. Diesel
      4. Rocket
      5. Gas Turbine
      Rotary
   B. External Combustion
      1. Steam
      2. Sterling

III. Transmission of Power
   A. Mechanical
      1. Belt and Drive Chains
      2. Cams
      3. Levers
      4. Screws
      5. Wheel and Axle
      6. Couplings
      7. Linkages
   B. Fluid
      1. Water Turbine
      2. Hydraulic
      3. Pneumatic

*IV. Atomic
   A. Fission
   B. Fussion

V. Research and Development
   A. Solar
   B. Fuel Cell
   C. Thermophotovoltaic Converter
   D. Thermoelectric Converter
   E. Thermionic Converter
   F. Magnetohydrodynamic Generator

*VI. Careers in Power Technology

* Recommended units of instruction for an 18-week course.

ELECTRICAL/ELECTRONIC TECHNOLOGY

COURSE CODE 10033

This course is designed to provide the student with an experimental introduction to basic electrical relationships, circuits and components and to modern electronic devices and circuits, with emphasis on practical applications.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Freshman Algebra or Permission of Instructor

SELECTED STUDENT COMPETENCIES

Experiences and activities in this industrial arts course should enable the student to:

1. Use electrical terms in conversation and writing.
2. Explain basic electrical relationships.
3. Read schematic diagrams and recognize electrical/electronic symbols, components and packages; also assemble simple experimental circuits.
4. Use basic electrical/electronic test instruments and interpret significance of readings.
5. Apply electrical knowledge to everyday situations.
6. Demonstrate safe electrical/electronic circuit and equipment handling practices.
7. Demonstrate residential wiring procedures.
8. Demonstrate basic electronic fabrication techniques.
9. Identify and select appropriate motors, generators and/or components for specific practical applications.
10. Explain basic semiconductor theory.
11. Explain operation of basic discrete semiconductor devices.
12. Explain how discrete and integrated devices are fabricated.
13. Construct basic circuits combining discrete active, passive and/or integrated devices.
14. Explain the basic operation of common analog electronic circuits.
15. Explain the basic operation of common digital circuits.
16. Identify circuits and devices used in everyday appliances, equipment, and personal conveniences.
17. Explain the scope and impact of the electronics revolution on his or her life and on society.

10033
COURSE CODE

ELECTRICAL/ELECTRONIC TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

*I. Introduction to Electrical/Electronic Technology
- A. Safety
- B. Occupational Information
- C. Scope of Industry Impact

*II. Electronics Industry Definitions
- A. Electricity Versus Electronics
- B. Analog Versus Digital
- C. Discrete Versus Integrated
- D. Passive Versus Active
- E. D.C. Versus A.C.

*III. Measurements and Instruments
- A. Multiples and Submultiples
- B. Current (flow) - Ammeter
- C. Voltage (pressure) - Voltmeter
- D. Resistance (opposition) - Ohmmeter
- E. Power (work rate) - Wattmeter
- F. Energy (work ability)

IV. Symbols, Components, Ratings
- A. Resistances
- B. Voltage Sources: Primary, Secondary, Storage vs. Continuous
- C. Connectors
- D. Controls

*V. Circuit Arrangements
- A. Series
- B. Parallel
- C. Combinations

*VI. Electrical Relationships
- A. Ohm's Law
- B. Watt's Law
- C. Relationships in Series and Parallel Circuits

*VII. Alternating Current Fundamentals
- A. Voltages and Currents: rms, peak, peak-to-peak
- B. Relationships of Time, Frequency, and Wavelength
- C. I Versus V Phase Measurements
- D. A.C. Visual Display - Oscilloscopes

VIII. Capacitive Circuits (D.C. and A.C.)
- A. Components, Symbols, Ratings
- B. Series and Parallel Arrangements
- C. D.C. - Storage and Time Constants
- D. A.C. - Capacitive Reactance

IX. Magnetism and Magnetic Circuits
- A. Permanent Versus Electro Magnets
- B. Applications - Relay, Solenoids, etc.
- C. Inductive Components, Symbols, Ratings
- D. Inductor Series and Parallel Arrangements
- E. Electromagnetic Induction
- F. Applications - Transformer, Ignition Coil, etc.
- G. A.C. Inductive Reactance

X. Frequency Selective Circuits
   A. RL Circuits - Filters
   B. RC Circuits - Filters
   C. LC Tuned Circuits

*XI. Motors and Generators
   A. Universal Motors and Generators
   B. Induction Motors and Generators - Single Phase
   C. Induction Motors and Generators - Poly Phase

*XII. Residential Electric Wiring
   A. Safety - Circuit Protection, Grounding, etc.
   B. Load Distribution
   C. Components, Symbols, and Ratings
   D. Specialty Circuits
   E. National, State and Local Codes

XIII. Careers in the Electrical Industry

XIV. Introduction to Electronic Applications
   A. Safety Considerations
   B. Occupational Information
   C. Scope of Industry Impact

XV. Discrete Semiconductor Devices and Circuits
   A. Basic Fabrication
   B. Diode Functions
   C. Transistor Functions (bipolar)
   D. Transistor Functions (field effect)
   E. Special Devices Functions
      1. Unijunction Transistor
      2. Diacs
      3. Triacs

*XVI. Integrated Devices and Circuits, Analog
   A. Amplifiers
   B. Timers and Oscillators
   C. Regulators, Power Supplies
   D. Receivers
   E. Transmitters

*XVII. Introduction to Digital Electronics
   A. Basic Binary Levels and Arithmetics
   B. Amplifiers - Inversion and Basic Gates
   C. Basic Level Indicators

XVIII. Basic Arithmetic Devices
   A. Adders and Subtractors
   B. Monostable Multivibrators and Timers
   C. Flip-flops
   D. Binary Counters

XIX. Basic Support Devices
   A. Shift Registers and Counters
   B. Presettable Counters
   C. Basic Memory Units
   D. Numeric Display Units

*XX. Basics of Microprocessors
   A. Types of Microprocessors
   B. Operation of Basic Microprocessors
   C. Analog-Digital Interfacing

XII. Microprocessor Applications
- A. Data Processing
- B. Machine Monitoring and Control
- C. Environmental Monitoring and Control
- D. Biomedical Applications
- E. Personal Convenience Devices

XXII. Careers in the Electronic Industry

* Recommended units of instruction for an 18-week course.

TRANSPORTATION TECHNOLOGY

COURSE CODE: 10061

This course is designed to provide students with the social/cultural developments related to efforts toward utilization of various modes of transportation to advance mobility. Emphases include the physical and human elements involved in the activities of people in the movement of themselves, their goods, or services from one point in a given environment to another point in the same or alternate environment.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

10 - 12

COURSE LENGTH

One period per day

18 weeks

UNIT OF CREDIT

½ unit

RECOMMENDED PREREQUISITES

None

SELECTED STUDENT COMPETENCIES

Experiences and activities of this industrial arts course should enable the student to:

1. Recall how energy is converted, transmitted, controlled, and applied to transportation systems.
2. Describe the basic operating principles of energy converters and how they can be applied to transportation systems.
3. Demonstrate safe practices in working with power systems, tools, and equipment.
4. Exhibit a willingness to use good work habits of orderliness, cleanliness, and care of property.
5. Identify, list and describe both technical and social/cultural problems related to transportation.
6. Interpret and analyze the technical systems used in transportation: (1) Energy source, (2) Propulsion, (3) Suspension, (4) Guidance, (5) Control, (6) Support.
7. Survey and discuss the environmental and energy imperatives that pertain to transportation technology.
8. Research and analyze the environmental divisions (terrestrial, marine, atmospheric, and space modes) of transportation technology.
9. Identify available occupational preparation programs related to transportation technology.

10061
COURSE CODE

TRANSPORTATION TECHNOLOGY

SUGGESTED INSTRUCTIONAL UNITS

I. Introduction to Transportation Technology
   A. Safety
   B. Environmental Mediums
   C. Technical Systems

II. Early Developments in Transportation
   A. Human Burden Bearing Devices
   B. Beasts of Burden Devices
   C. Mechanical Powered Vechicles

III. Classification of Technical Systems
   A. Energy Sources
   B. Propulsion
   C. Suspension
   D. Guidance
   E. Control
   F. Support

IV. Terrestrial Modes (Random Route)
   A. Carriages
   B. Bicycle
   C. Motorcycle
   D. Automobile
   E. Trucks and Buses
   F. Roadways
   G. Technical Systems

V. Terrestrial Fixed Routes
   A. Trolley
   B. Rail Transportation
   C. Technical Systems

VI. Stationary Conveyance Systems
   A. Pipelines
   B. Conveyor Belts
   C. Elevators and Escalators
   D. Technical Systems

VII. Marine Modes of Transportation
   A. Mechanical Powered Units
      1. Ships
      2. Tankers
      3. Barges
   B. Canals and Inland Waterways
      1. Channels
      2. Locks
      3. Gates
   C. Technical Systems

VIII. Atmospheric Modes of Transportation
   A. Lighter-Than-Air Craft
      1. Airships
      2. Balloons
   B. Heavier-Than-Air Craft
      1. Fixed-wing
      2. Rotary-wing
   C. Airports and Elements
   D. Technical Systems

IX. Space Transportation and Vehicles
   A. Manned Systems
   B. Unmanned Systems
   C. Technical Systems

X. Transportation and the Future
   A. Urban Transit
   B. Personal Rapid Transit (PRT)
   C. Technical Systems

XI. Transportation and Energy

XII. Transportation and the Environment

XIII. Occupational Information

INDIVIDUAL TECHNICAL PROBLEMS: ENERGY/POWER

COURSE CODE 10092

This individual technical problems course is designed for students who have had the Level II preliminary course of this cluster in the chosen area of study and intend to study specific advanced topic(s) in energy sources, power technology, electrical/electronic technology and/or transportation technology.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

See Course Description

SELECTED STUDENT COMPETENCIES

Instruction in this industrial arts course is open to meet students needs. The following suggested objectives are meant to provide ideas for developing the student's program.

1. To prepare students for seeking advanced education in the area of energy/power.
2. To provide students the experiences in problem-solvng, research and development, and technical report writing with regard to any chosen topic in energy/power.
3. To provide students with opportunities for exploration in energy/power systems and the practical application of scientific principles related to these systems.
4. To provide students with a broader understanding of career opportunities in energy/power.

10092
COURSE CODE

INDIVIDUAL TECHNICAL PROBLEMS:

ENERGY/POWER

SAMPLE LEARNING UNITS

ENERGY SOURCES:

I. Gasahol Production
II. Solar Heating and/or Cooling
III. Solar Photovoltaic Banks
IV. Wind or Water Energy Conversion Systems
V. Energy Storage Systems

POWER TECHNOLOGY:

I. Stirling Engine/Heat Pump
II. Steam Engine
III. Dynomometers for System Analysis
IV. Hydraulic/Pneumatic Controls

ELECTRICAL/ELECTRONIC TECHNOLOGY:

I. Amateur Radio
II. Alarm Systems
III. Trouble Shooting Communications Equipment
IV. Vehicular and Other Microprocessor Control Units

TRANSPORTATION TECHNOLOGY:

I. Electrical Vehicle Propulsion
II. Linear Induction Motor Propulsion
III. Air Suspension Systems

INDIVIDUAL TECHNICAL PROBLEMS

COURSE CODE 10091

This individual technical problem course is designed for students who have not had the opportunity to enroll in specific Level II subject matter courses in the Energy/Power Technology cluster area. The course is designed to provide a means for meeting individual student needs through the offering of multiple activities in a number of technical areas in schools where separate courses are not available.

INDUSTRIAL ARTS PURPOSE

Personal Enrichment

Pre-Technical

GRADE LEVEL

11 - 12

COURSE LENGTH

One period per day

18 or 36 weeks

UNIT OF CREDIT

½ or 1 unit

RECOMMENDED PREREQUISITES

Level I Curriculum Courses

SELECTED STUDENT COMPETENCIES

NOTE: Individual student competencies and learning experiences are to be identified and developed on a contractual basis by the student and approved by the instructor for each problem.

SAMPLE LEARNING TOPICS

NOTE: Learning topics for the ITP are to be selected from the instructional units identified for each specific subject matter course. These courses include:

ENERGY/POWER:

- Energy Sources, 10038
- Power Technology, 10039
- Electrical/Electronic Technology, 10033
- Transportation Technology, 10061

SUMMARY/CONCLUSIONS/RECOMMENDATIONS

Our concern for the curriculum of schools prompts us all to continually seek ways to assess "what is" and identify ways to improve the educational activities and experiences now provided. Recognition of this need by North Dakota industrial arts teachers led to the development of a Program of Studies Guide for Senior High School industrial arts education.

Industrial arts education provides opportunities for students in elementary and secondary education to develop an understanding of the technical, consumer, occupational, recreational, organizational, managerial, social, historical, and cultural aspects of industry and technology.

The industrial arts program of studies presents the complete secondary school industrial arts curriculum recommended for grades seven through twelve for North Dakota secondary schools. The Level I Junior High School guide was developed earlier and has been implemented in the past four years. Consequently, the emphasis in this research project was to develop a senior high school program of studies articulated with the Level I guide.

The three types of Industrial Arts programs for North Dakota secondary schools are: (1) Orientation and Exploration; (2) Personal Enrichment; and (3) Pre-Technical.

The general goals are broad in nature and provide unique opportunities for the student to learn about industry and its supporting technologies. The curriculum and program of studies is centered around three technical conceptual areas: (1) Graphic Communications Technology; (2) Production Technology; and (3) Energy/Power Technology.

The content base has been derived from the three conceptual technical areas with emphasis on exploration in depth and beginning specialization regarding the present practices and future developments occurring in industry and technology. Each course student competencies to be developed through creative and problem-solving learning experiences involving such activities as experimenting, planning, designing, constructing, evaluating and using tools, materials, and processes. The instructional and laboratory experiences provide students with knowledge to help them make wise educational and occupational choices.

Recommendations:

1. This guide should be implemented in all secondary schools in North Dakota during the next three years.
2. The guide should be complemented by an instructional resource guide for each of the courses identified.
3. The guide should be complemented by local teacher prepared instructional materials, lesson plans, assignment sheets, progress sheets and student reference materials to enhance instruction.
4. The program standards should be reviewed and audited regularly by the State Industrial Arts Supervisor to assure that standards are maintained.
5. An objective funding criteria should be established for funding programs that meet standards.
6. Articulation of junior high and senior high school industrial arts and Vocational Trade and industrial programs should be continually monitored to avoid duplication of services in a given school district.
7. Industrial Arts & Vocational Trade & Industrial programs should plan instructional programs cooperatively thereby keeping harmony, yet maintaining their separate identity.

REFERENCES

Industrial Arts Program of Studies. Industrial Arts Education Service, State Department of Education, Richmond, Virginia, 1978.

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North Dakota Vocational-Technical Education - Program Standards. State Board For Vocational Education, Bismarck, North Dakota, 1978.

North Dakota Industrial Arts Level I Curriculum Guide. Industrial Arts Education Services, North Dakota State Board for Vocational Education, Bismarck, North Dakota. 1977.

North Dakota Suggested Master Plan for Industrial Arts Education. Industrial Arts Education Services, North Dakota State Board For Vocational Education, Bismarck, North Dakota. 1975.